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ABSTRACT

Data collected in the National Science Foundation's Survey of Graduate Science and Engineering (S/E) Students and Postdoctorates, fall 1987 are presented. The survey noted that foreign students account for about one seventh of all students enrolled in graduate S/E programs. Graduate S/E enrollment in all institutions is up 1% from the previous year, and for the past decade, the steady rise in the number of non-United States citizens enrolled full-time in doctorate-granting institutions has been important to the growth of graduate S/E enrollment. Graduate enrollment in engineering rose 2% from 1986 to 1987, compared to a growth of less than 1% in the sciences. Both increases were lower than the rates of growth over the last decade. Nearly 76,200 non-U.S. citizens were enrolled full-time in graduate-level S/E programs in doctorate-granting institutions. Women comprised 34% of the total full-time S/E students at doctorate-granting institutions in 1987. Research assistantships supported 69,800 full-time graduate students in doctorate-granting institutions in 1987, and this mechanism was the most rapidly growing type of support. Institutional funds continues to be the largest single source of support for such students. Doctorate-granting institutions employed 25,300 postdoctorates in fall 1987, up 5% since 1986. Foreign citizens made up 43% of the postdoctorates. Tables and charts are included.(SM)

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SCIENCE RESOURCES STUDIES HIGHLIGHTS

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# Foreign Students Account for Most Growth in Graduate Science and Engineering Enrollment

## Highlights

- Total graduate science and engineering (S/E) enrollment in all institutions reached almost 450,000 in fall 1987, a 1-percent increase over 1986. Most of the 1986-87 growth was attributable to non-U.S. citizens, whose numbers grew by 5 percent while the number of U.S. citizens remained level.

- Graduate enrollment in engineering, which accounted for about one-fourth of the total graduate S/E enrollment, rose 2 percent from 1986 to 1987, compared to a growth of less than 1 percent in the sciences. Both these increases were lower than the rates of growth over the last decade.

- Mathematical sciences was the fastest-growing science field, up 4 percent in 1987. In contrast, enrollment in the computer sciences declined by 1 percent, after an average annual growth of 14 percent between 1977 and 1986.

- The 170,100 women in graduate S/E programs represented 38 percent of the total 1987 S/E graduate enrollment. From 1986 to 1987, for the first time, the growth rate for women was almost identical to that of men—about 1 percent. In contrast, between 1977 and 1986, the number of women increased at an average annual rate of 5 percent, compared to an average 1-percent rise for men.

- Research assistantships supported 69,800 full-time graduate students in doctorate-granting institutions in 1987, up from 65,600 in 1986. This mechanism was the most rapidly growing type of support, increasing by 7 percent since 1986. Three other types of support either leveled off or showed only slight increases. The number of teaching assistants, which had grown for most of the past decade, remained level at 61,000 in 1987. The number of traineeships leveled off in 1987, after declining steadily from almost 19,000 in 1979, when separate traineeship data were first collected, to 14,000 in 1986. During the same period, the number of fellowships rose from 20,300 to 23,100, an average growth of 2 percent per year. The 1987 number, however, was down 1 percent from the 1986 peak.

- Institutional funds continued to be the largest single source of support for full-time graduate students enrolled in doctorate-granting institutions; 110,700, or 42 percent, were supported primarily by their institutions in 1987. The number depending primarily on Federal Government support reached 53,600, from a low of 47,200 in 1982. The 1987 federally supported total represented a 4-percent increase over 1986, and was the highest number since 1977. Increasing support from the Department of Defense, the National Science Foundation (NSF), and the National Institutes of Health accounted for most of the growth.

- This report presents data collected in NSF's Survey of Graduate Science and Engineering Students and Postdoctorates, Fall 1987. Estimated total figures are based on responses from all 327 doctorate-granting institutions and a stratified random sample of the 294 U.S. institutions with one or more master's-level programs in science and engineering fields. Aggregate data are believed to be accurate within 1.1 percent at the 95-percent confidence level. Responses were received from 96 percent of the departments surveyed; estimates for non-response made up about 6 percent of the graduate S/E enrollment total shown in this report. Unless otherwise specified, data in this report relate to all students enrolled in programs leading to graduate S/E degrees in all institutions.

## Total Graduate S/E Enrollment

Graduate S/E enrollment in all institutions reached 449,600 in fall 1987, up 1 percent from the previous year. During the past decade, the steady rise in the number of non-U.S. citizens enrolled full time in doctorate-granting institutions has been a major factor in the growth of graduate S/E enrollment. This group increased 4 percent from 1986 to 1987, following a 10-percent increase a year earlier. In view of the slowdown in the growth rate of U.S. undergraduate enrollment in recent years, the number of S/E graduate students with U.S. citizenship is likely to show little if any growth in the near future. In



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contrast, further increases in the number of foreign students are anticipated. As a result, the pattern of slow overall growth characteristic of the last few years is likely to continue.

Engineering enrollment reached 106,900 in 1987, a growth of 2 percent, compared to an increase of less than 1 percent in the sciences. In both areas, this marks a slowing of the growth from the 1977-86 trends (chart 1). Engineering graduate students comprised 24 percent of the fall 1987 graduate S E enrollment, compared to 19 percent a decade earlier.

Data from recent annual surveys of engineering enrollment in U.S. institutions conducted by the American Society for Engineering Education indicate a significant decline in undergraduate enrollment. It should be noted that the ratio of foreign students to U.S. citizens is much lower at the undergraduate level than at the graduate level; hence, undergraduate enrollment is primarily useful in projecting future enrollment of U.S. citizens at the graduate level. Unless the number of foreign students pursuing graduate study in the engineering fields continues to increase at a substantial rate, the growth rate of graduate engineering enrollment may be significantly lower in future years than in the last decade.[1]

[1] Richard A. Ellis, "Engineering and Engineering Technology Enrollments, 1987," in *Engineering Education*, October 1988, p. 52, table 1.

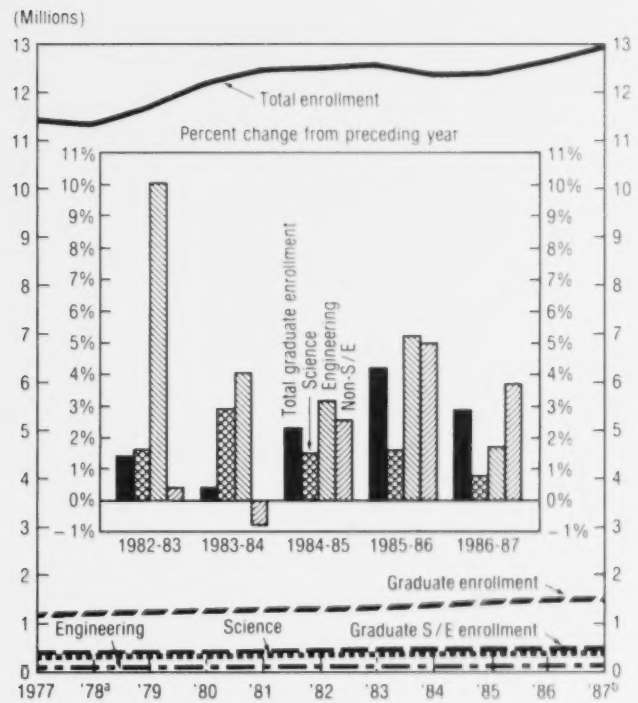
Electrical engineering remained the largest engineering subfield, with 31,300 graduate students enrolled. This represents a 3-percent growth over the 1986 figure, one-half the 6-percent average annual growth in the previous decade. Mechanical engineering, the fastest-growing of the major engineering subfields, rose by 4 percent from 1986 to 1987, after increasing by an average of 5 percent per year from 1977 to 1986.

Enrollment in the life sciences was still the largest among the science fields, at 108,600, or 32 percent of all graduate students enrolled in the sciences—about the same share as throughout the 1977-86 period.[2] Life science enrollment rose less than one-half of 1 percent from 1986 to 1987, compared to an average increase of just over 1 percent per year over the preceding decade.

The computer sciences declined for the first time, by 1 percent; the average annual increase was 14 percent in the 1977-86 period (table 1). A sharp drop, nearly 11 percent, in part-time enrollment in master's-granting institutions was primarily responsible for the decrease.

[2] For consistency with other data reported in the Academic Science and Engineering survey series, data for the life sciences include graduate students enrolled in master's and Ph.D. programs in the health sciences, but not those in programs leading to a first-professional degree.

**Chart 1. Total and graduate science/engineering (S/E) enrollment in all institutions**




[a] Includes interpolated data for master's-granting institutions.
[b] NCES data for 1987 represent preliminary estimates.
SOURCES: Department of Education, NCES, and National Science Foundation, SRS.

**Table 1. Graduate science/engineering (S/E) enrollment in all institutions by field, enrollment status, and sex: 1986 and 1987**

| Field | 1986 | 1987 | Average annual percent change 1977-86 | Average annual percent change 1986-87 |
|---|---|---|---|---|
| Total, all S/E fields | 445,000 | 449,600 | 2 | 1 |
| Engineering | 105,100 | 106,900 | 5 | 2 |
| Chemical | 7,000 | 7,200 | −3 | 3 |
| Civil | 15,500 | 15,300 | 1 | −1 |
| Electrical | 30,200 | 31,300 | 6 | 3 |
| Industrial | 13,400 | 14,000 | 7 | 4 |
| Mechanical | 15,500 | 16,200 | 10 | 4 |
| Other | 23,500 | 23,000 | 6 | −2 |
| Sciences, total | 339,900 | 342,700 | 2 | 1 |
| Physical sciences | 32,700 | 33,200 | 5 | 2 |
| Environmental sciences | 15,300 | 14,700 | −3 | −4 |
| Mathematical sciences | 18,400 | 19,100 | 1 | 4 |
| Computer sciences | 30,600 | 30,200 | 4 | −1 |
| Life sciences | 108,200 | 108,600 | 1 | 0 |
| Agricultural sciences | 11,300 | 10,900 | −1 | −3 |
| Biological sciences | 48,600 | 48,800 | 2 | 1 |
| Health sciences | 48,200 | 48,900 | 1 | 1 |
| Psychology | 43,700 | 44,900 | 0 | 3 |
| Social sciences | 91,100 | 91,900 | 2 | 1 |
| Full time | 278,600 | 279,200 | 3 | 2 |
| Part time | 166,400 | 166,900 | 1 | −1 |
| Men | 276,600 | 277,300 | 2 | 1 |
| Women | 168,400 | 168,800 | 3 | 1 |

SOURCE: National Science Foundation, SRS.

Full-time enrollment of S/E graduate students in all institutions rose by more than 2 percent from 1986 to 1987, reaching 285,200, compared to a growth of less than 2 percent in the previous 10-year period. Part-time enrollment, at 164,400 in 1987, was down 1 percent from the 1986 total, after rising at an average rate of 3 percent per year in the preceding decade. S/E graduate students in doctorate-granting institutions continued to outnumber those in master's-granting institutions by about six to one. Graduate S/E enrollment in master's-granting institutions, 60,900 in 1987, has declined steadily from the 63,100 enrolled in these institutions in the peak year, 1984.

### Racial/Ethnic Background

Minority graduate students continued to account for about one-seventh of all U. S. citizens enrolled in graduate S/E programs. Those of Asian/Pacific Island background made up 5 percent of the total for whom racial/ethnic data were provided in 1987, followed by non-Hispanic blacks and Hispanics at 4 percent each. Asian graduate students increased 15 percent from 1986 to 1987, followed by those of Hispanic background, up 6 percent. The number of blacks fell by less than 1 percent.

### Full-Time Graduate Students in Doctorate-Granting Institutions

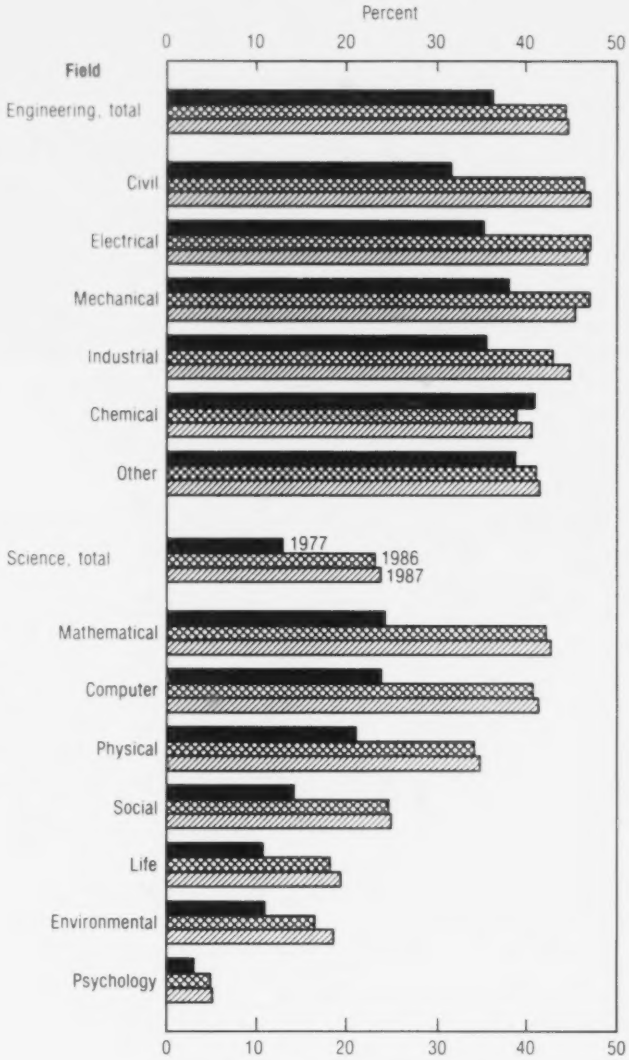
The remainder of this report presents data for the 264,900 S/E graduate students enrolled full time in doctorate-granting institutions. These students comprised 59 percent of the total S/E graduate enrollment in all institutions. Furthermore, foreign students were more likely to enroll in doctorate-granting institutions: Of the 93,100 foreign students reported, 82 percent were enrolled full time in doctorate-granting institutions, compared to only 53 percent of the S/E graduate students with U. S. citizenship. These institutions also accounted for 99 percent of all academic expenditures for research and development in 1986, and employed about two-thirds of the Nation's academic scientists and engineers in 1985.

### Citizenship and Field of Study

Nearly 76,200 non-U.S. citizens were enrolled full time in graduate-level S/E programs in doctorate-granting institutions. Of all full-time S/E graduate students in all fields in U.S. institutions, 28 percent were noncitizens, compared to only 3 percent of all undergraduate students.[3] A worldwide market for education at the doctorate level suggests that S/E graduate enrollment trends are more influenced by international economic and political factors than are undergraduate enrollment trends, while fluctuations in the U.S. birthrate play a more important role at the undergraduate level. For example, in the aftermath of the uprising which overthrew the Imperial Government in Iran, the total number of Iranian students enrolled in American universities and colleges plummeted from 51,300 in fall 1979 to 10,400 in fall 1987.[4]

**Field of study.** In engineering, almost 45 percent of all full-time graduate students in 1987 were non-U.S. citizens, on either temporary or permanent visas, up from 36 percent in 1977. This includes 47 percent of those in the civil and electrical subfields, and 45 percent of those in mechanical and industrial engineering. Foreign students made up 24 percent of the 1987 total in the sciences, up from 13 percent in 1977. The extent of foreign participation varied significantly across the fields of science. In the mathematical and computer sciences, the foreign proportion exceeded 40 percent. At the opposite extreme, fewer than 5 percent of the full-time graduate students in psychology were non-U.S. citizens (chart 2).

**Chart 2. Foreign proportion of total graduate science/engineering enrollment in doctorate-granting institutions**




SOURCE: National Science Foundation, SRS

[3] Institute for International Education, preliminary data, as reported in *Higher Education and National Affairs*, November 30, 1987, p. 3.

[4] Institute for International Education, *Open Doors: 1986/87* (New York, N.Y., 1987), p. 19, and preliminary data published in "Students From Asia Made Up More Than Half of All Foreigners at U.S. Colleges Last Year," *The Chronicle of Higher Education*, October 26, 1988, pp. A39-A40.

Of the doctorates awarded to foreigners in 1986 and 1987, 21 percent went to permanent U.S. residents, i.e., immigrants who had entered the country with the expectation of remaining and becoming U.S. citizens.[5] Of those who had studied in this country on temporary (primarily student) visas, about one-half of those with firm commitments reported plans to be employed in the United States.[6]

### Women

Women comprised 34 percent of the total full-time S/E students at doctorate-granting institutions. Women were underrepresented in the engineering fields where, despite a 14-percent average annual growth since 1977, they were still only 12 percent of all full-time engineering students in 1987. In the sciences, 41 percent of all full-time graduate students were women; in two fields—the health sciences and psychology—the majority of graduate students were women, 68 percent and 60 percent, respectively.

### Source and Type of Major Support

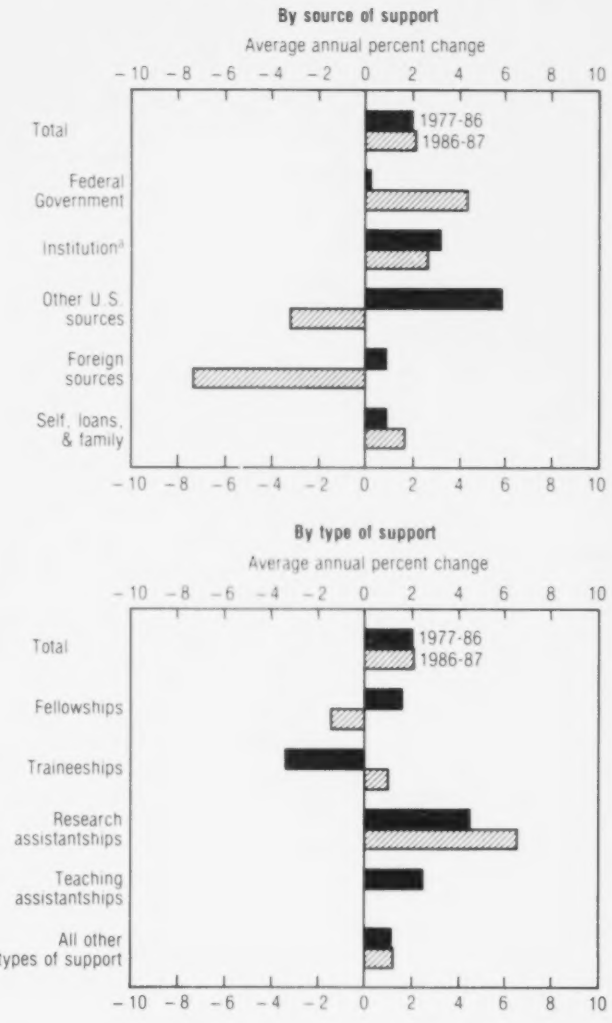
**Source of support.** The number of graduate students receiving their primary support from Federal agencies rose by 4 percent from 1986 to 1987, to 53,600. The 1987 level surpassed the previous peak year, 1980, and reflects the steady increase in Federal obligations to academic institutions, support for research and development and combined support covering fellowships, traineeships, and training grants which characterized the 1982-85 period.[7]

The Department of Health and Human Services remained the largest agency source of graduate student funding throughout the decade, supporting 17,600, or about one-third of all those relying primarily on Federal funding. NSF ranked second, providing major support to 11,200 students. The number of students receiving primary support from their institutions grew by 3 percent—to 110,700—and accounted for 42 percent of all S/E students. The number relying primarily on their own funds (including loans and family) rose slightly, to 75,200, but was still below the maximum of 75,700 reported in 1983.

**Mechanisms of support.** Research assistantships remained the most common mechanism for outside funding in 1987, increasing by almost 7 percent to 69,800. The number of graduate students primarily supported under teaching assistantships outnumbered research assistantships for most of the last decade, but remained stable at 61,000 in 1986 and 1987. The number of fellows, up to 23,400 in 1986, declined by 1 percent in 1987, to 23,100, while the steady drop in the number of trainees awarded was reversed. The 13,900 reported in 1986 increased to 14,100 in 1987—still only three-fourths of the number a decade earlier (chart 3). In part, this apparent decline in the number of traineeships reported may reflect growing standardization of definitions as institutions have adopted more consistent terminology for fellowships, traineeships, and other forms of assistance.

Institutions provided the majority of the teaching assistantships and fellowships, while Federal agencies were the largest source of funding for research assistantships. NSF supported the largest number of federally funded research assistantships, 27 percent of the total, and 34 percent of the federally financed fellowships. The NSF share of federally funded support has risen since 1980 from 26 percent of research assistantships and 28 percent of fellowships, respectively.

**Chart 3. Full-time science/engineering graduate enrollment in doctorate-granting institutions**




[a]Includes State and local government funds
SOURCE: National Science Foundation, SRS

[5] According to statistics from the Survey of Earned Doctorates sponsored by NSF and other Federal agencies, as published in National Science Foundation, *Science and Engineering Doctorates: 1960-86*, Detailed Statistical Tables, NSF 88-309 (Washington, D. C., 1988), table 13, pp.182-184

[6] Ibid. A student visa requires the holder to return to his home country after completing his studies and places certain restrictions on his activities while in the United States. For example, he is required to maintain full-time enrollment and his ability to seek outside employment is limited.

[7] National Science Foundation, *Federal Support to Universities, Colleges, and Selected Nonprofit Institutions: Fiscal Year 1986*, A Report to the President and Congress, Detailed Statistical Tables, NSF 88-315 (Washington, D.C., 1987), p. 9, table B-1.

## Postdoctorates Employed in Doctorate-Granting Institutions

Doctorate-granting institutions employed 25,300 postdoctorates in fall 1987, up 5 percent since 1986. As in prior years, about two-thirds of these were in the life sciences, with the physical sciences accounting for most of the remainder.

Foreign citizens made up 43 percent of the postdoctorates, 41 percent of those in the sciences and 65 percent of those in engineering. By comparison, in 1979, the first year in which separate data were collected on postdoctorates, the proportions were 32 percent in the sciences and 61 percent in engineering (chart 4).

In the science fields, the 1987 foreign proportion ranged from a high of 56 percent in the physical sciences to a low of 16 percent in psychology. All fields, however, showed significant increases in the percent of total which were not U.S. citizens (table 2).

* * * * * * *

Detailed Statistical Tables for *Academic Science/Engineering: Graduate Enrollment and Support, Fall 1987* will be available on diskettes early in 1989. For further information on the tables, contact Mr. J. G. Huckenpahler, Division of Science Resources Studies, at (202) 634-6082.

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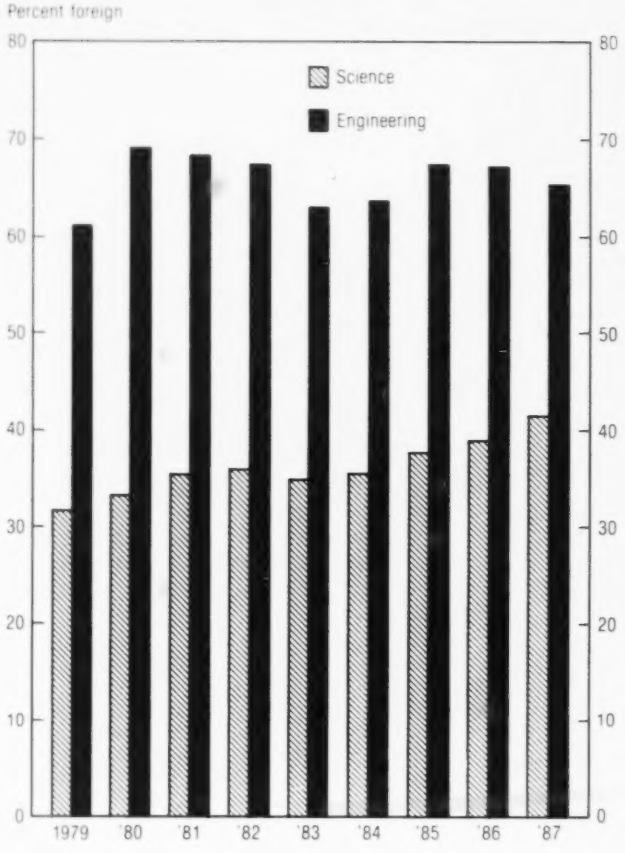
Chart 4. Foreign as a percent of total science/engineering postdoctorates in doctorate-granting institutions




SOURCE: National Science Foundation, SRS

Table 2. Science/engineering postdoctorates employed in doctorate-granting institutions by field and citizenship: 1979 and 1986-87

| Field | 1979 | | | 1986 | | | 1987 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | Foreign | Percent foreign | Total | Foreign | Percent foreign | Total | Foreign | Percent foreign |
| Total | 18,086 | 6,054 | 33.5 | 24,035 | 9,775 | 40.7 | 25,270 | 10,795 | 42.7 |
| Engineering | 1,067 | 653 | 61.2 | 1,402 | 941 | 67.1 | 1,479 | 966 | 65.3 |
| Sciences | 17,019 | 5,401 | 31.7 | 22,633 | 8,834 | 39.0 | 23,791 | 9,829 | 41.3 |
| Physical sciences | 4,025 | 2,014 | 50.0 | 4,843 | 2,640 | 54.5 | 4,740 | 2,640 | 55.7 |
| Mathematical science | 162 | 80 | 49.4 | 201 | 101 | 50.2 | 228 | 110 | 48.2 |
| Environmental sciences | 315 | 110 | 34.9 | 418 | 142 | 34.0 | 421 | 164 | 39.0 |
| Life sciences | 11,625 | 3,049 | 26.2 | 16,223 | 5,745 | 35.4 | 17,443 | 6,719 | 38.5 |
| Computer sciences | 38 | 13 | 34.2 | 74 | 29 | 39.2 | 110 | 34 | 30.9 |
| Social sciences | 400 | 101 | 25.3 | 352 | 127 | 36.1 | 395 | 89 | 22.5 |
| Psychology | 454 | 34 | 7.5 | 522 | 50 | 9.6 | 454 | 73 | 16.1 |

SOURCE: National Science Foundation, SRS